

probe tip may be copper, steel, or a metal including at least one of silver, copper, steel, and stainless steel. In various embodiments, the housing may be plastic or metal. The housing may include a flange disposed about said probe housing, and a spring may be used in conjunction with the flange. The housing may include an integrated flexible member.

[0012] Some embodiments of this aspect of the present invention include a well of a predetermined size and shape. The well mates with the probe and the probe tip is thermal coupled to said well.

[0013] In accordance with one aspect of the present invention the well includes a hollow housing of a thermally conductive material. The housing has an outer surface and an inner surface. The inner surface is a predetermined shape so as to form a mating relationship with a sensing probe. The mating thermally couples the inner surface with a sensing probe.

[0014] Some embodiments of this aspect of the present invention include a predetermined volume of thermal grease on the inner surface of the well.

[0015] In accordance with one aspect of the present invention, method for determining temperature and conductivity of a subject media in a cassette is described. The method includes the following steps: installing at least one well in a cassette; thermally coupling a well and a sensing probe such that temperature and conductivity can be determined; transferring thermal and conductivity signals through at least 3 leads from the sensing probe; and determining temperature and conductivity using the signals.

[0016] In accordance with another aspect of the present invention, a method for detecting air in a fluid line contained in a cassette is described. The method includes the following steps: installing at least one well in a cassette; thermally coupling at least two wells located in a fluid line to sensing probes such that temperature and conductivity can be determined; transferring conductivity signals through at least 3 leads from the sensing probes; determining conductivity for each sensing probe; calculating the difference of conductivity from each sensing probe; and determining if the difference exceeds a threshold.

[0017] In accordance with another aspect of the invention there is provided apparatus comprising a fluid conduit in a cassette including a well for at least one of transmitting temperature and permitting conductivity sensing of fluid passing through the conduit, wherein the well is adapted for interconnection with a sensor.

[0018] In various alternative embodiments, the apparatus may be configured so that a portion of the well comes into contact with fluid in the conduit or so that no portion of the well comes into contact with fluid in the conduit. The fluid conduit in the cassette may include plastic tubing or metal tubing.

[0019] In various embodiments, the cassette containing the fluid line comprises a rigid body overlaid on one or more sides with a flexible diaphragm. In various embodiments the flexible diaphragm cassette includes one or more pump chambers and/or one or more valve stations. In various embodiments, one or more wells are positioned on the edge of the cassette. In certain of these embodiments, one or more wells are positioned on the bottom edge of the cassette.

[0020] In various embodiments, the cassette has a rigid front and/or back plate. One or more wells may be installed in the rigid cassette. Alternatively, one or more sensor leads

may be installed in the rigid cassette. In various embodiments, the rigid cassette may contain one or more pod pumps.

[0021] The cassette and the well may be integrally formed from the same material.

[0022] Alternatively, the well may be coupled to the cassette, e.g., using at least one of press fit connection, flexible tabs, adhesive, ultrasonic weld, and a retaining plate and fastener. An o-ring may be disposed between the well and the fluid conduit. The o-ring may include one of a round cross-section, a square cross-section, and an X-shaped cross-section. The well may include a groove to receive a portion of the o-ring. A portion of the well in contact with the conduit may be flexible so as to deform the conduit and may include a plurality of cuts to provide such flexibility.

[0023] In accordance with another aspect of the invention there is provided a fluid pumping apparatus comprising at least one pump and a well for at least one of transmitting temperature and permitting conductivity sensing of fluid passing through the conduit, wherein the well is adapted for interconnection with a sensor. In various alternative embodiments, the at least one pump may include at least one pod pump and may include a pair of pod pumps. The at least one pump and the well may be integrated into a cassette.

[0024] In accordance with another aspect of the invention there is provided a sensing system comprising at least one sensing probe and at least one well installed in a cassette, the well in communication with the sensing probe for at least one of thermal sensing and conductivity sensing.

[0025] In accordance with another aspect of the invention there is provided a sensor manifold comprising a cassette and at least one sensing probe for at least one of thermal sensing and conductivity sensing. In various embodiments, the sensor manifold contains two or more fluid paths and two or more sensing probes for at least one of thermal sensing and conductivity sensing. In various embodiments, the sensor manifold is passive with respect to controlling the flow of the fluid in the fluid paths within the cassette. In such embodiments, the sensor manifold may be free from valves and pumping mechanisms. In various embodiments, the sensor manifold may comprise a cassette with a rigid front and/or back plate and a mid-plate. In various embodiments, the sensor manifold may comprise electrical circuits connected to the sensing probes. In certain of these embodiments, the sensor manifold may comprise a printed circuit board.

[0026] These aspects of the invention are not meant to be exclusive or comprehensive and other features, aspects, and advantages of the present invention are possible and will be readily apparent to those of ordinary skill in the art when read in conjunction with the following description, the appended claims, and the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0027] The foregoing features of the invention will be more readily understood by reference to the following detailed description, taken with reference to the accompanying drawings, wherein:

[0028] FIGS. 1A and 1B are embodiments of the sensing apparatus where the thermal well is a continuous part of the fluid line;

[0029] FIGS. 2A and 2B are embodiments of the sensing apparatus where the thermal well is a separate part from the fluid line;